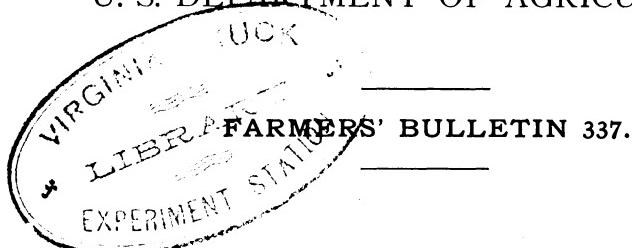


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Issued October 27, 1908.

U. S. DEPARTMENT OF AGRICULTURE.



CROPPING SYSTEMS FOR NEW ENGLAND
DAIRY FARMS.

BY

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., July 30, 1908.

SIR: I have the honor to transmit herewith a paper entitled "Cropping Systems for New England Dairy Farms," by Mr. L. G. Dodge, Scientific Assistant, Farm Management Investigations.

This paper gives the results of three years' study of the cropping systems on a number of the most successful dairy farms in New England. This study has enabled Mr. Dodge to point out the elements which go to make a satisfactory cropping system in that section and to make definite recommendations concerning crops to plant and the relative acreage of these crops on dairy farms. I recommend that this manuscript be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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CROPPING SYSTEMS FOR NEW ENGLAND DAIRY FARMS.

INTRODUCTION.

New England is preeminently a section of small farms, due largely to the generally broken character of the country, the farming land being located in small areas scattered among the hills. Since the farms are small, some type of intensive farming must be followed to make them profitable. Since the land has already been tilled longer than good land will bear an exploitative system of farming, some type of live-stock farming is a necessity on most farms. As the most intensive form of stock farming is dairying, this latter industry is naturally the leading one on New England farms. Dairying, in the main, has been a profitable business in New England, but in recent years conditions have changed, and the outlook is not so satisfactory as it has been at various times in the past.

Some of the difficulties which are at present most evident are the high prices of concentrated feeds and of labor. Some sections of New England, furthermore, feel the pressure of unsatisfactory market conditions, especially those sections which ship milk to the large cities, where the farmers are offered a price for their milk on which they can hardly make a profit.

Outside of the milk-shipping sections the difficulties mentioned do not appear, on careful observation, to be the most fundamental, although they are the most obvious. Taking the Northeastern States of the Union as a whole, owing to climate and topography the land is in general adapted to the growth of grass and trees. The fact that grass is so much at home in those States has led to a serious fault in New England dairy farming, namely, the mismanagement of grass lands. This consists in the main of a lack of proper treatment for permanent grass lands and of suitable rotations for other land, as well as the use for grass growing of land which does not give profitable returns from grass and which should rightfully be devoted to tree growth, either as woodland or orchards. Another frequent and wide-

spread fault is the habit of cutting the hay crop entirely too late in the season, which of itself shortens the life of the meadow and results in an inferior quality of hay for dairy feeding.

Closely associated with poor management of grass lands is the failure to utilize other crops available for this section, especially corn. In southern New England there is little difficulty in growing good silage corn, but as one travels northward there is evidence of a lack of suitable varieties of corn for silage. This difficulty is not insuperable. There are varieties of corn that can be grown for silage in all but the most northern counties in New England. What is most needed is that sufficient attention be given to the selection of seed in order to develop strains of corn fitted to the requirements of the different sections.

Some of the best dairy farms of the country are to be found in New England. They are scattered here and there all over the New England States. A careful study has been made of the cropping systems on a large number of these farms. The results of this study are set forth in the following pages. No recommendations are made here that are not already known to have been practiced on profitable dairy farms in the section concerned.

CROPPING SYSTEMS DESCRIBED.

F FARMS IN NORTHERN NEW ENGLAND.

In the northern part of New England there are several dairymen who have demonstrated that the average dairy farm there is working at only a small fraction of its capacity. Among them the Hon. C. L. Jones, of Penobscot County, Me., raises all the roughage and some of the grain for 40 head of cattle, 4 horses, and 20 sheep on 40 acres of tillage, and spares from this area 3 or 4 acres for potatoes every year. About 12 acres of flint corn are grown each year for silage, nearly as much small grain, a mixture of oats and barley, and the remainder of the 40 acres, aside from the potatoes, is devoted to hay. The rotation comprises one year of corn, one of small grain, one of clover hay, and part of the land is run for mixed hay a second year. The land is seldom left in hay more than two years before it is again plowed up for corn, making either a three-year or a four-year rotation.

The manure is mostly applied in the late summer and fall with a manure spreader, both as a top dressing to the new seeding or other grass land and to the land to be used for corn the next year. It is applied at the rate of ten loads per acre for either purpose. The seeding is done with the grain in the spring. Mammoth clover is seeded at the rate of 12 to 14 pounds to the acre, with 2 or 3 pounds of redtop and 4 quarts of timothy. The result of the short rotation,

the frequent manuring, and the heavy seeding is a crop of 3 tons of hay to the acre at one cutting. Other crops yield in proportion, so that this farm furnishes feed for so large a number of stock that it seems unreasonable to the average dairyman. The results of Mr. Jones's methods are readily apparent upon looking at his hay crop, which is illustrated in figure 1. The photograph was taken where the mower had just passed.

The farm of Mr. Paul Ames, of Kennebec County, Me., furnishes another instance of high farming on a small acreage. This farm furnishes the forage for 11 grown cattle, 3 young cattle, and 2 horses.



FIG. 1.—Mammoth clover on farm of C. L. Jones, Penobscot County, Me. Photographed early in July.

There are 40 acres of pasture for summer feed. The tilled land amounts to 16 acres, of which about 11 are used for grass and clover hay, 4 for peas and oats, and 1 for potatoes. The land is not adapted to corn growing owing to its moist condition, but produces two crops of hay each season. As much as is used for peas and oats is seeded, along with the grain, with 10 pounds of red clover, 1 peck of timothy, and 6 pounds of reedtop to the acre. This seeding is done about the middle of May, and the peas and oats are cut for grain about the middle of August.

The grass land yields a cutting of hay between the 1st and the 10th of July, or even beginning in June, and a second crop about August 20. To cure the second crop it is allowed to wilt, then put in the heap and

left for three days. The two cuttings yield upward of 3 tons per acre of a very fine quality. Before it is plowed again the condition of the grass land is kept up four and even five years by an annual application, after haying, of 9 or 10 loads of stable manure per acre as a top dressing.

Mr. Ames's cows averaged in a recent year 230 pounds of butter fat. Counting the value of cream actually sold and grain purchased, both taken from careful records, he says that the hay is worth \$18 a ton to him, allowing each cow $2\frac{1}{2}$ tons per year. This shows what a good quality of hay will do under circumstances which prevent the growing of silage corn. In addition to his other stock, Mr. Ames keeps 10 or 12 hogs, to which he feeds the skim milk.

One of the first men to show to Maine dairymen the possibilities of their land was the late R. W. Ellis, of Somerset County. He long since demonstrated that an acre of sweet corn grown in a short rotation on land kept in good condition by frequent application of manure would yield from 10 to 12 tons of silage after the well-filled corn was picked for the cannery. He also showed that with grain alone silage from this corn at the rate of 60 to 70 pounds a day would keep a cow in condition. The acre of sweet corn, then, would easily provide roughage for a cow for two hundred days during such part of the year as she could not be pastured. Mr. Ellis further demonstrated that every acre of good quality hay grown on land, likewise in good condition from the short rotation and judicious manuring, would furnish roughage for a cow for the year and to spare, outside of the pasture season. The quality of his hay was made fit for dairy cows by seeding heavily to clover, at the rate of 6 pounds of red clover and 4 pounds of alsike to the acre, together with the usual peck of timothy. When these two feeds, the silage and the mixed hay, are combined he has excellent roughage for dairy stock.

The opportunities in New Hampshire for the developing of profitable and intensive dairy farms have not been demonstrated nearly so plainly as they have in Maine. For one thing, the majority of New Hampshire dairymen are confronted with the unsatisfactory market conditions already mentioned which are attendant on shipping milk to the large cities. Again, many farmers in New Hampshire have in recent years depended on summer boarders, putting too much reliance in the statement that this is the only profitable crop they can cultivate, since their lands are poor and the scenery the principal natural asset of the State. They have likewise paid too little attention to the intensive development of profitable dairying.

Prof. J. W. Sanborn, however, has been demonstrating for some time what may be done to improve New Hampshire farms by a more intensive system and a short rotation, and though his work has been done on a large scale so far as acreage is concerned, his rotations are

adaptable to the smaller acreages which, on account of the broken topography, are the only ones available to many New Hampshire dairymen. Professor Sanborn has on his large farm some 400 acres of tilled land suited to frequent plowing and rapid rotation, besides 100 acres of permanent meadow, and another 175 acres of permanent pasture.

The 400 acres of easily plowed land are put in a rotation as follows: Corn, one year; peas and oats for hay, one year; clover for hay, two cuttings, one year; potatoes to sell, one year; Hungarian millet for hay, one year; timothy for hay to sell, two years, and then one year of pasture.

This is virtually two good rotations, one following the other, the two covering eight years, and gives 50 acres in each lot of land, allowing 50 acres for potatoes, 100 acres for hay to sell, and 250 acres to raise roughage for the live stock. Of this 250 acres, 50 are in good pasture after the hay is cut and before plowing for corn again. This leaves 200 acres for hay and silage, which, together with 100 acres of permanent meadow, 50 acres of pasture in rotation, and 175 acres of permanent pasture, provide roughage for 140 milk cows the year round, and during the winter for some 100 additional head of young stock which are pastured at a distance in the mountains during the summer. The grains for the supplementary feeding are necessarily purchased.

The hay from the whole of the cleared land in 1894, when Professor Sanborn took the farm, amounted to 112 tons. In 1905 the yield was 800 tons, this increase being accomplished by frequent plowing of the land and frequent applications of manure, which serves to illustrate on a large scale what has been shown already in other places in New England, namely, that land which can be plowed conveniently, and is therefore adaptable to a rapid rotation, can by this kind of treatment generally be made to produce the roughage^a necessary to keep a cow for each acre, at least, if it be supplemented with pasture for part of the summer feed of the cow.

The fundamental principle on which Professor Sanborn is working is that it is fully as much the amount of milk or butter produced per acre which counts as it is the amount per cow, and he is developing the land accordingly. To build up a dairy farm on a small acreage, of course, it becomes necessary to leave out the potatoes and hay to sell and to devote all the tilled land to the support of the herd.

As an illustration of what may be done in this direction in New Hampshire, the farm of Mr. D. H. Noyes, of Grafton County, may be cited. This farm comprises 18 acres of tillable land and 150 acres of rough pasture. The tilled land is kept in a four-year rotation of one

^a The term roughage is equivalent to the expression "coarse fodder" as it is frequently used in New England, including hay of all kinds, silage, corn stover, etc.

year each of corn for silage, oats for hay, clover hay, and mixed hay, and provides the coarse feed for 11 cows, 3 young cattle, 3 horses, and 32 sheep. The grain purchased amounts to only 1 ton per month as an average for the year.

In Vermont there are some of the best object lessons in dairying that are to be found in New England. In the dairy sections of that State one very frequently hears of a small dairy farm of from 100 to 200 acres in all, rough land included, which has given the owner an average of \$1,000 a year profit above his living for the past two decades. This high state of development of dairy farming in Vermont is not so much due to the quality of the soil as it is to the systems of cropping and fertilizing the land.

The farm of C. F. Smith, of Lamoille County, is an admirable example. On this farm 75 acres of tilled land, with as much more in pasture, provides the roughage and part of the grain for 55 milk cows, 25 young cattle, and 8 horses. The pasture provides feed for the young cattle during the summer, but the cows get some feed in the barn at all seasons, even when the pasture is at its best.

From 20 to 25 acres of the tillable land are taken up every year with corn for the silo, as much more with oats or a little barley or Japanese millet, and the remainder with clover and timothy hay. This necessitates frequent plowing of the land in rotation, giving one year of corn, one of small grain, then one year, or in part two years, of hay on each lot. The result is that this plan, together with frequent manuring, gives to the acre, even in this northern part of the State, 15 tons of ensilage and 4 tons of hay, and oats have at times yielded 90 bushels.

Hay is cut during the last days of June or early in July, and again early in September. This practice, together with that of allowing the land to grow hay only one year, or two at the most, results in an average of 4 tons of hay per acre, two cuttings, and that of a very fine quality for dairy feeding. Any hay which is cut in unfavorable weather is put into an old silo, a new and much larger one having been built for the corn.

In seeding his grass, Mr. Smith uses a peck of clover, a peck of timothy, and 10 pounds of redtop to the acre. The manure is applied as a top dressing in the fall to the grass lands, then hauled out several times during the winter to the land set aside for corn the following spring. Any corn land remaining is supplied in spring after the ground is dry enough to haul over. Mr. Smith attributes his success to his frequent plowing of all his land and his method of applying manure, especially top dressing.

The possibilities of another type of cropping system are exemplified by that in use on the farm of F. E. Wilson, of Chittenden County.

This farm consists of about 65 acres of tilled land and 60 acres of rough land, which furnishes sufficient pasturage for the present live stock for nearly four months in the year. On the farm are kept 35 cows, 10 to 15 young cattle, and 5 or 6 horses, and the only feed purchased for them for the entire year is about a ton of cotton-seed meal and 2 tons of bran.

The rotation followed is corn for silage, one year; a mixture of peas, oats, and barley for grain, one year; and hay, two years. This four-year rotation allows about one-half of the 65 acres to be in hay each year, a fourth in silage corn, and a fourth in grain. The mixture of peas, oats, and barley is thrashed and ground and fed to any or all of the live stock as needed, with the slight addition of the purchased grain already mentioned.

With this cropping system, even though well supplemented by summer pasturage, it will be noted that the number of live stock is not equal to the number of acres of tillage, but it will be further remarked that the bill for purchased grain is reduced to a minimum. Frequent plowing and the application of manure have, as in the other cases, made this degree of intensity possible. This farm has found one solution of the problem now so pressing, namely, that of purchasing grain. Another solution of this same problem is exhibited by the system of crops on the farm of H. B. Chittenden, also in Chittenden County.

The Chittenden farm comprises 175 acres of tilled land and some 75 acres additional of rough land which furnishes pasturage for only about two months for the present number of cattle on the place. This pasture season lasts only from the middle of May to the middle of July; the other ten months of the year a full winter ration is required. On this farm are kept approximately 110 cows, 25 young cattle, and 15 horses. Besides supplying this stock with the required coarse fodder, some 90 to 100 tons of hay are sold each year, thus furnishing from the farm an equivalent for the grain purchased. .

The rotation on a large part of the 175 acres is silage corn one year, followed by two years of clover and timothy for hay. The remaining smaller portion of the land is run in a four-year rotation of silage corn, one year; part peas and oats for hay and part millet for hay, one year; and clover and timothy for hay, two years. In the case of the three-year rotation the grass is seeded in the corn late in July with a wheelbarrow seeder. The corn is cut for silage with a corn harvester in September, and the grass makes two hay crops the following season. All hay, in fact, is cut twice in a season, whether in the first or second year or whether seeded in the corn or with the small grain crops, and it yields from 2 tons upward at each cutting.

All the seeding is done at the rate of 1 peck of timothy, 8 quarts of red clover, and 4 quarts of alsike clover to the acre, whether in the

corn or otherwise. Manure is applied to all of the land every year at the rate of 10 or 12 spreader loads per acre, whether to the grass as top dressing or elsewhere.

One of the most intensively operated farms that has come to notice in Vermont is that of F. L. Davis, of Windsor County. This farm comprises 96 acres in all, of which a scant 30 is tillable, about 30 more being in pasture, and the remainder is in woodland.

This farm produces all the coarse fodder for 25 milk cows, 15 young cattle, and 6 horses. About 6 acres are put in corn for silage each year, 2 acres in peas and oats for hay, and the remaining tilled land is in hay.

Hay is raised on any field two years only, as a rule, but part of the



FIG. 2.—Second crop of red clover on farm of F. L. Davis, Windsor County, Vt. Photographed at the end of August.

land sometimes runs a third year. The first crop of hay is cut very early, usually beginning about June 25, and a second crop is cut at the end of August. The annual yield per acre averages very close to 4 tons. The newly seeded fields often produce 3 tons at the first cutting and 2 at the second, of the finest quality of hay, mostly clover. The quantity of hay in a second crop of this clover is shown in figure 2. The field shown had already yielded nearly 3 tons per acre at the first cutting, having been seeded in corn the year previous. The adjoining field of corn has been seeded for hay for the year following. The seed used amounts to 20 quarts per acre, of which half is clover. The seeding is done in the corn late in July, with very satisfactory results.

The only commercial fertilizer used on the farm is 200 pounds per acre on the corn. The manure from the relatively large herd is applied to all the crops, on the corn land during winter or spring and as top dressing on the grass. This farm in 1890 could scarcely support 12 cows, 2 oxen, and a pair of horses. It was raised to its present state of productiveness first by applying commercial fertilizer, especially that high in potash, to all the land until a good clover stand was obtained. Then the further increase was accomplished by the use of the clover in increasing the number of live stock as well as the humus in the soil, and the increase of live stock was further aided by the additional manure. After the clover was once established the use of commercial fertilizer, with the exception of that used on the corn, was discontinued.

F FARMS IN SOUTHERN NEW ENGLAND .

In southern New England the same cropping systems that have been described in Vermont work admirably, and with even greater success, owing to the fact that corn will make a somewhat larger yield of ensilage. In addition to examples of the kind of cropping systems already described, there are in Massachusetts some instances which illustrate methods suited to rather different conditions. When for one reason or another land is not well suited to corn growing it may still be made to support a relatively large number of cattle.

Mr. William B. Avery, of Franklin County, Mass., frequently winters 20 cows and 6 or 7 horses on the roughage from 18 acres of land. Most of this acreage remains in grass for five years at a time. To renew the seeding of each lot after that length of time it is usually plowed after the first crop of hay is off, perhaps during the latter part of July, and after being turned about 8 inches deep is rolled, then dressed with 15 spreader loads of barnyard manure, harrowed thoroughly twice with the spring-tooth harrow, sowed with a mixture of timothy, red clover, and alsike clover, and rolled again. This land is a stony loam, and at that season of the year rolling only helps make the surface moist enough for the seed to germinate.

The grass and clover both get sufficient start before freezing weather to survive the winter in good condition and produce two good crops of hay the following season. Two crops are cut each year thereafter. The yield is kept up during the five years by an annual top dressing of stable manure rather lighter than the application used in seeding down. By this system four years out of five the land produces two good crops of hay, and the fifth year it produces one crop before it is reseeded for another five years.

Sometimes an acre or so of corn is grown on part of the land that is to be reseeded. In that case the corn is cultivated level and the seed-

ing is done broadcast in the corn about July 25, a full month earlier than is necessary when seeding alone, as previously described. When seeding in the corn a somewhat larger amount of seed is used than when seeding alone.

In this connection it is well worth noting that a few farmers in New York State follow a plan much like that described above, with this addition: They apply 4 or 5 pounds of mixed red and alsike clover seed to the acre on the old sod each spring. Sometimes this is done by sprinkling a proportionate amount of the seed on each spreader load of manure as it goes out for top dressing, or if the top dressing is done in the fall the clover is sown broadcast by the man who drives the brush harrow over the grass land in the spring, the brush harrow then accomplishing two purposes, that of breaking the clods of manure and that of working the seed into the surface soil. This addition of clover seed is of great advantage to the dairyman, for it keeps up the mixture of clover in hay grown on land which it is impracticable to plow more frequently.

There is another type of cropping system which appears to be adapted mainly to farms located close to some large city, where land is scarce and the demand for milk is so good that the farmer needs a greater proportion of silage or other succulent feed, even at the cost of buying some hay. This plan is to grow a series of crops which furnish green feed from the middle of May to November 1. So much of each crop as may be is fed green. When a crop reaches the stage of maturity where it would no longer be fit to feed green, it is made into hay or put in the silo. This allows of increasing the quantity of succulent feed without using all of the land for corn, and thus distributes the labor of men and teams through the season in a way which could not be done in growing the same acreage of corn alone.

In the vicinity of Boston, rye sown September 10 is ordinarily fit to cut for feed May 15 and lasts until about June 5. Winter wheat and vetch sown September 20 is fit to feed from June 5 to July 1, and any left over makes good hay. Oats and peas sown first April 18 will be fit to feed by July 1, and successive seedings, even up to July 1 on low land, will furnish green feed until September 1. If the later seedings must be omitted for lack of suitable land, green corn planted May 15 will fill the gap until a frost comes. Barley sown from June 20 to August 15 in successive lots will furnish feed for September and October. Under any other circumstances than those I have described it does not seem economical to follow this system, for summer feeding of silage saves the daily labor of cutting and hauling a green crop on any farm where there is land enough to use for growing good clover hay in a rotation with silage corn. In this connection it is well to note the heavy clover crops grown in that manner, as illustrated in figures 1 and 2.

There are considerable sections in southern New England where all the dairy farms are engaged in supplying milk to the numerous smaller cities. Such is the case not only in part of Massachusetts but in considerable portions of Rhode Island and Connecticut.

Within the city limits of Providence, R. I., there is an example of a cropping system much like that just described, where on 60 acres are grown silage, soiling crops, and hay sufficient for 7 horses and 60 cows the whole year and 40 additional cows for nine months. The first year this cropping system was instituted it was necessary to buy 4 carloads of hay, the second year 1 carload, and the third year none would have been needed for this number of stock, but 2 carloads were bought because 100 cows were kept for a much longer season than before. Enough hay was made from the oats and peas, the millet, and other similar crops to supply that needed for the original number of cows, and enough mixed clover and timothy was grown for the horses.

R. L. Sadd, of Windsor County, Conn., on 80 acres of land provides roughage for 40 cows and 7 horses and is at present accumulating a surplus of hay and silage to provide for an increase in the number of cows. About half of his land is too low and moist for corn, but is excellent grass land, while 30 acres of the farm is upland, on all of which corn is grown every year and which is especially suited to this crop. Of the 50 acres of permanent meadow, 5 are sufficiently dry for alfalfa, and by especial care a good stand of this crop has been obtained on that area.

These conditions make it rather difficult to keep up the production of both corn and grass; but by manuring the corn land every year with 12 loads to the acre and by top dressing the grass land frequently and reseeding it generously the production of corn is sufficient to furnish silage for the present herd and the grass lands supply sufficient hay. Much of the corn land is also sowed to rye in the fall, which is plowed under for the corn again in the spring.

The herd is constantly growing as the crop yields increase. By the end of this year the herd will consist of 54 cows and 1 bull. The additional manure promises to increase the yields sufficiently to furnish roughage for the added stock.

Because of the impracticability of rotating crops on this farm, Mr. Sadd has found that it requires \$10 worth of commercial fertilizers to produce the necessary coarse fodder for each cow, but with this amount of fertilizer he has accumulated sufficient feed to provide for one season with the increased number of stock. It is to be remembered that the cows get no pasture at all, but are stall fed the entire year. It seems probable that when the number of cows reaches the maximum the cost for additional fertilizer will be somewhat less than now. At best, however, Mr. Sadd feels the effects of the inability to use a rotation of clover and corn in the added expense of growing his crops.

Mr. Thomas Holt, also of Hartford County, Conn., has a farm comprising 74 acres of tilled land, on which he keeps 70 head of grown cattle, 25 young cattle, and 6 horses. All of the roughage for this stock is provided for the entire year, except that some of the young cattle are kept on hired pastures during the summer. The pastures on the farm do not count as feed, as they are little more than an exercise lot for a herd of 70.

The rotation is usually one of three years, but is sometimes extended to four. Corn for silage is grown one year. As soon as the crop is off in September the land is harrowed thoroughly and sown broadcast to rye. As early the next spring as a team can be put on the land, the rye is gone over four or five times with the smoothing harrow and seeded broadcast before the last harrowing with 15 pounds of red clover to the acre. The harrowing is done entirely regardless of the rye and with the sole purpose of preparing a good seed bed for the clover. The rye is so hardy, however, that it soon recovers from the harrowing and makes an excellent crop for green feed or other uses. Some of it is cut and fed green, but the greater part is made into hay or chopped into one of the silos, which by that time is empty. A little of the rye, sufficient for seed the next year, is left to ripen. If the season be favorable—that is, not too dry—two crops of clover are cut after the rye which is cut green, and one after the rye cut for grain. Then the clover is top dressed in the fall and cut either two or three times the second year, according to the season.

In most cases this ends the rotation and corn begins again. In some lots, however, this rotation is varied by planting corn two years in succession before seeding clover. In that case the corn stubble of the first year is sown to rye just the same, and the rye is plowed under for the second crop of corn. Rye follows the corn again the second year and the clover is seeded in this the next spring.

Another variation is that of cutting the rye without sowing clover, following it with Japanese millet, and seeding clover in the millet. The millet may be fed green in part, but most of it is put into the silo, for which purpose it is as satisfactory as corn.

The several sources of silage give sufficient succulent food to compensate for the scanty pasturage, and the variety of crops used no doubt makes the silage more palatable. The manure is hauled from the barn every day in the year, for at most seasons there is some place to spread it. About 800 loads a year are produced, and this covers all the land once. Besides the manure some Canadian hard-wood ashes have been applied to each field in succession for the purpose of improving the clover stand. The result has been to insure such a growth of clover as has been described—two or three crops a year.

At least half of the present tilled land was not long since in rough and very stony pasture and has been cleared of stones a field at a time.

The farm is on a hilltop which is far from smooth. The whole system of management of crops, live stock, and labor on Mr. Holt's farm is so satisfactory that it is planned to treat it more fully later in a separate bulletin.

CONCLUSIONS.

In order to present the relation of the number of live stock to the acreage under the several systems of crop production, the figures for the several farms have been tabulated as follows:

TABLE I.—*Acreage of New England farms discussed in this bulletin, and number of live stock on each.*

Farm.	System.	Tilled land.	Pasture.	Number of cattle.		Tillable land per animal. ^a	Pasture per animal.
				Cows.	Young stock.		
Jones.....	Silage.....	Grain purchased.....		Acres.	Acres.	Acres.	Acres.
	do.....	do.....		40	40	b 1.09	1.00
Sanborn.....	do.....	do.....	c 200	225	140	100	.9
Noyes.....	do.....	do.....	18	150	11	3	.95
Smith.....	do.....	do.....	75	75	55	25	.93
Chittenden.....	do.....	do.....	175	100	110	25	.75
Davis.....	do.....	do.....	28	36	25	15	.9
Holt.....	do.....	do.....	74	40	70	25	.42
Sadd.....	do.....	do.....	80	-----	45	-----	.77
Wilson.....	do.....	Grain raised.....	65	60	35	12	1.56
Ames.....	No silage.....	Grain purchased.....	16	40	11	3	1.23
Avery.....	do.....	do.....	18	-----	20	-----	2.85
						.90	-----

TABLE II.—*Acreage of the several crops on New England farms discussed in this bulletin, and percentage of land in each crop.*

Farm.	Tilled land.	Approximate number of acres <i>g</i> in—			Tillable land.		
		Corn.	Other cereals. ^b	Grass and clover.	In corn.	In other cereals. ^b	In grass and clover hay.
Jones.....	Acres.	40	12	10	14	30	35
Sanborn.....		200	50	100	f 150	25	25
Noyes.....		18	4.5	4.5	9	25	50
Smith.....		75	22	22	31	30	40
Chittenden.....		175	58	17	100	32	58
Davis.....		28	6	2	20	21.5	71
Holt.....		74	25	20	29	34	31
Sadd.....		80	30	-----	50	37.5	62.5
Wilson.....		65	16	k 16	32	25	50
Ames.....		16	-----	4	11	25	f 70
Avery.....		18	i 2	-----	16	11	89

^a On most of these farms 2 horses are kept for each 18 or 20 cattle. The horses do not use any pasture, but must be counted in connection with the crops raised. In reckoning tillable land or pasture per animal, 2 young cattle or 5 sheep are considered the equivalent of 1 cow.

^b In reckoning tillable land per cow only that used for raising feed is counted.

^c Figures on the Sanborn farm refer only to the part used to supply dairy feeds.

^d On the Noyes farm 32 sheep are kept in addition to the cattle, and so the surplus pasture is partly utilized.

^e Considerable hay is sold annually from the Chittenden farm.

^f There is no pasture on the Sadd farm. Cows are stall fed the year around.

^g These figures are only approximate, for the acreages vary slightly from year to year.

^h Includes either Japanese or Hungarian millet on a few farms.

ⁱ On the Jones and the Ames farms, respectively, a small area out of the tilled land is used for potatoes.

^j Includes 50 acres of permanent pasture.

^k On all except the Wilson farm other cereal crops than corn are used for hay or silage. On the Wilson farm they are cut for grain.

^l All corn raised is for silage except on the Avery farm, where corn is raised for grain, and figures there apply only to winter feeding.

When the results attained on the several farms just described are considered, it will be seen that there are three factors which have contributed most to the results: First, the proper use of stable manure; second, putting into a short rotation all land suited to it and, third, the proper handling of land which is suited only to grass.

A short rotation of three or four years, such as described in connection with several of the farms—for instance, those of Messrs. Davis and Holt—accomplishes three things. The first and most frequently recognized is the turning down of a good sod, especially a clover sod, every third or fourth year, a practice which furnishes a large supply of humus and fertilizing material, thereby producing larger yields of corn, small grains, or other crops. Secondly, the frequent breaking up of the sod, growing a tilled crop, and then seeding down again keeps up the yield of grass during such part of the time as the land is producing a hay crop. This increase in yield of hay is largely due to the clover, which can not be kept in the hay more than two years without reseeding, since it is a biennial. For these reasons it is obvious that such clover crops as those shown in the cuts contribute both directly and indirectly to the success of these cropping systems. Thirdly, a short rotation permits the growing of some cash crop like potatoes on part of the land, and that without seriously depleting the soil, as is likely to occur when a crop of that kind is grown on the same lot continuously.

When land is suited to grass growing only, as is frequently the case with land in New England, either on account of being too moist or from having too many rocks at a short distance below the surface to allow frequent plowing, the problem of keeping up the yield is more difficult. This problem is solved, however, by some of the farmers whose work has just been cited. The essentials in keeping up the yield of permanent grass land on a dairy farm in New England appear to be, first, the applying annually of small quantities of barnyard manure as a top dressing. Eight or 10 spreader loads per acre each season are much better than 20 or 30 loads every second or third year. If the farm does not have a manure spreader on it, it is somewhat more difficult to apply so light a coating, but when spread as well as possible by hand a brush harrow will break up the lumps and scatter them satisfactorily.

The use of a large proportion of clover seed when seeding down gives a better quality of hay for two years at least, and the clover improves the yield of the true grasses which are sown with it. Not only that, but it has been shown that the addition of small amounts of clover seed on top of the old sod in the spring is profitable.

It will be noted that with successful dairymen in New England one of the most general practices is that of cutting the hay crop early, which not only allows the cutting of a second crop, like that shown

in figure 2, but gives a far better quality of hay for making milk. Two cuttings yield more and better hay than the one late cutting. It may be well to explain that by early cutting is meant a time before any of the grasses or clovers in the mixture have had time to ripen and get dry and hard. As far north as Windsor County, Vt., in a normal season, Mr. Davis's hay harvest is found to be in full swing by June 27.

By practicing the fundamental rules in crop production just described, namely, the intelligent use of manures, the following of short rotations, and the good management of grass lands, many dairymen are already doing as much as can be done by the individual farmer toward solving the two obvious difficulties of getting the necessary concentrated feeds to supply protein in the feeding rations and of meeting the scarcity of farm labor. The first of these difficulties is remedied because the methods practiced result in a far more palatable as well as more nutritious quality of coarse fodder in the bright, early-cut hay, in the corn ensilage, and especially in clover and peas in the hay.

These last two classes of hay do a great deal toward supplying the protein of a dairy ration, and the small grain that is grown on several of the farms described supplies still more, whether it is fed in the straw, as the pea and oat hay of some of the farmers, or thrashed out, as Mr. Wilson finds it profitable to do.

The relief of the labor situation is brought about because the real problem for a farmer is not how to get any kind of cheap help, but how to be able to pay for reliable help such as will stay by him and can be trusted to handle live stock. When land yields so much more than the average that an acre will feed a cow, the return will pay for better help than otherwise for two reasons. One is that a man in going over 10 acres produces more value in crops, and the other is that by growing a variety of crops in a rotation the labor is so distributed through the season that rush seasons, such as haying time, with the accompanying high price for extra labor, are done away with, or at least greatly reduced.

Thus the dairyman on the large farm can utilize labor more uniformly and get the yields to pay for it, while the small farmer finds his labor distributed so that he and the other members of his family can handle the work without hiring, as in the case of Mr. Noyes, of Grafton County, N. H.

The crops mainly to be depended on in New England for feeding dairy cows are corn, three varieties of clover (red, alsike, and mammoth), oats, field peas, barley, Japanese millet, Hungarian millet, winter rye, winter wheat, and winter vetch. There may be some surprise that timothy, redtop, and perhaps some other true grasses are not included in the list, but they are intentionally omitted

because they do not furnish so good a quality of hay for dairy cows as any one of the other hay crops mentioned.

All the crops named, except corn and Japanese millet, are excellent hay crops. From several of the crops either grain or roughage may be obtained, but from them a fine quality of feed is obtained when the crop is harvested only partly matured. This is a feed that is really roughage but which contains so much grain that it is either richer or more palatable than ordinary hay made from the true grasses. This statement applies to silage made from corn cut when the ears are glazing, as well as to the small grain when cut for hay.

Attention is especially called to the ways in which Japanese millet is utilized by several of the farmers already mentioned, as this crop is well adapted to the climate of New England. It should also be noted that winter rye furnishes the earliest green feed in the spring for soiling and the earliest hay crop. Further, winter wheat and vetch sown together furnish one of the best milk-producing hay and soiling crops, the second earliest, following closely after rye. The quality of this mixture of wheat and vetch is such that when it is fed green and then replaced by peas and oats milk production is observed to be materially lessened, although the combination of peas and oats is recognized to be one of the best of green feeds. Wheat and vetch also make a first quality hay if cut when the wheat is in the dough stage.

TABLE III.—*Quantity of seed required and dates of planting and harvesting for the latitude of Concord, N. H.^a*

Crop.	Quantity of seed per acre.	Date of planting.	Date when fit for soiling.	Date when fit for silage or hay.
Corn.....	12 quarts.....	May 18-25.....	August 10.....	September 10.
Oats.....	{1 bushel.....			
Peas.....	{mixed.....			
Barley.....	{1 bushel.....	April 25 to May 10.	July 5.....	July 25.
Barley.....	{1½ bushels.....			
Barley.....	{3 bushels.....	July 1.....	September 1.....	September 20.
Winter rye.....	{3 bushels.....	September 1-20.....	May 20.....	June 10.
Winter wheat.....	{2 bushels.....	September 1-20.....	June 10.....	July 1-5.
Winter vetch.....	{mixed.....			
Japanese millet.....	{30 pounds.....	June 1-30.....	July 5-30.....	August 1-30.
Hungarian millet.....	{30 pounds.....	June 1-30.....	July 20 to August 20.	August 1-30.
Clover.....	{12 pounds.....	{April 10-30..... (August 1-25.....)	June 15.....	June 25-30.

^a The dates given are for a normal season. For points to the north or south of Concord or in higher altitudes some allowance needs to be made, but the differences will be rather slight.

GENERAL RECOMMENDATIONS.

The methods which are to be generally recommended to dairymen in New England for the producing of feed apply equally to much of the State of New York, at least to all the eastern portion of it. They are briefly as follows:

In the first place, all land which can be used at all in such a manner should be kept in a short rotation, not more than three or four or, at

the most, five years long. This should bring the time which any piece of land is used for hay before replowing down to two or three years at the most. This short rotation gives more clover in the hay, since clover is short-lived, only good for two years from the time of seeding, at best. The clover not only improves the quality of the hay, but when hay is grown for three years increases the yield of the hay crop for a year after the clover is gone. If cut for hay only two years the clover materially aids the yield of corn or other crop which immediately follows it.

If, as is often the case, a good catch of clover is not easily obtained, the land should be limed, for too much acidity in the soil seems to be the greatest drawback to clover culture in New England. Land plaster, wood ashes, or fertilizers containing much potash contribute to the same end. The only precaution to be observed is in the case of a farm where potatoes are an important crop, for then one must be cautious about liming; potato scab may thereby be increased. In that case a fertilizer high in potash, such as is used for potatoes, does much to improve the clover crop.

When land is such that a short rotation is impracticable, there are certain precautions to be taken to keep up the yield and quality of hay. The first is, and it is always possible on a dairy farm with a herd of any size, to top dress the grass lands lightly every year. This is the most important point in the handling of New England permanent grass lands. Aside from this it is advisable to apply to such lands small amounts of clover seed every year on top of the sod. Both of these practices are described in detail in the preceding pages. Finally, whether hay be grown in rotation or on permanent grass land, it must be cut early if intended for dairy cows.

Some or all of the soiling crops mentioned are frequently desirable to fill gaps, and when silage or hay is scarce they may be desirable to feed all summer, along with silage. It should be remembered, however, that the use of a soiling system for the whole season is not, as a rule, advisable on account of the labor involved. Wherever it is possible to grow corn the silo should be depended upon, not only for winter feeding but for the entire twelve months in the year in case pasture is scarce or poor in quality. It is the cheapest way to get succulent summer feed if the land is at all limited in area or if the pastures are not such as to produce good feed in dry weather. In parts of Massachusetts large milk producers consider that it costs 1 cent a quart more to produce milk without silage than with it.

The chief difficulty in growing silage corn in northern New England is in getting a suitable variety, and farmers are strongly urged to take advantage of such new varieties of silage corn as may be offered for trial by the agricultural experiment stations of their respective States

or by the United States Department of Agriculture, and also to select their own seed in order to improve it.

In the most northern sections, such as northern Maine, where corn is out of the question and potatoes fill the place of corn in a rotation, silage can still be made from Japanese millet or other crops and succulent winter feed thus provided. Clover and Italian rye-grass are successfully used for silage in the State of Washington. This combination is worthy of trial in northern Maine.

It should be noted that all or nearly all of the cropping systems that have been mentioned here are dependent on different variations of one rotation. Several different rotations may compose the system on any farm, and one rotation may follow another on the same field, or different fields may be used continuously in different rotations. The rotations, however, are based on the one so common in many localities—that is, corn, small grain, grass. Corn may be replaced by potatoes, and that is very profitably done in the potato districts or in the most northern counties of New England, where corn fails. The small grain may be left out and the grass (and clover) seeded in the corn, or corn may be grown two years instead of one.

The number of years of hay growing may vary from one to five, and the small grains may be used as grain or go to supplement and enrich the supply of hay. Even the rotations for a soiling system are usually based on the same foundation, the crops for soiling coming after corn, two of them frequently being grown in a year, and then the land put back in corn again.

The essentials of the New England dairyman in growing feed for his cows appear to be the use of a short rotation wherever possible; all the clover hay and corn silage that can be grown; liming the land for clover if need be; better management, especially in the use of manure, of land which is not fit for short rotations; and the utilizing of the various other crops that have been mentioned to fill the gaps with succulent feed or add in quantity and quality to the ordinary hay crop